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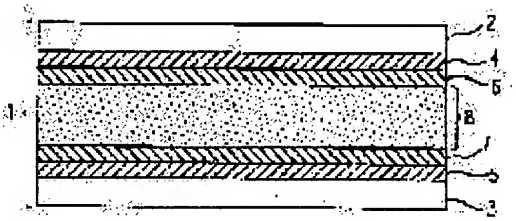
(71)Applicant : SHARP CORP
(72)Inventor : HASHIMOTO YOSHITO
YAMAHARA MOTOHIRO
MIZUSHIMA SHIGEMITSU

(54) VISUAL ANGLE VARYING ELEMENT AND VISUAL ANGLE VARIABLE LIQUID CRYSTAL DISPLAY DEVICE USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To make it possible to obtain transmittance of about the same degree as the degree of the conventional liquid crystal display device at a low cost and to change its visual field angle.

SOLUTION: A visual field angle varying element 1 provided with a liquid crystal layer 8 between substrates 1 and 2 formed with transparent electrode layers 4, 5 and oriented films 6, 7 is disposed between a polarizing plate and a liquid crystal display element. The recognition of images exclusive of the images right above the liquid crystal molecules of the liquid crystal layer 8 is not possible if the liquid crystal molecules are oriented perpendicularly to the substrates 1, 2. The phase state of the liquid crystal layer 8 changes to an isotropic state and the ordinary visual field angle characteristics are obtainable when voltage is impressed between the transparent electrode layers 4 and 5 from this state. The ordinary wide visual field angle characteristics are obtd. if the orientation direction of the liquid crystal molecules of the liquid crystal layer 8 and the rubbing direction of the liquid crystal display element are made parallel or perpendicular when the liquid crystal molecules are oriented in parallel. The orientation state of the liquid crystal layer 8 changes and the liquid crystal



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the angle-of-visibility adjustable liquid crystal display incorporating the new angle-of-visibility adjustable component to which an angle-of-visibility property can be changed, and its angle-of-visibility adjustable component.
[0002]
[Description of the Prior Art] As a display, the liquid crystal display is used widely conventionally. Recently, taking advantage of the thin shape which is the description of a liquid crystal display, and a light weight and a low power, rapid expansion is seen to fields, such as the display and cellular phone TV of a word processor, a computer, etc., and car navigation TV. Moreover, it is predicted that various images are openly used by the expansion of a liquid crystal display excellent in such portability, and overflow by it in the future, and it is thought that privacy protection of the individual about an image becomes important.
[0003] Below, the conventional liquid crystal display is explained. Generally, the liquid crystal display is widely used for numerical segmental-die displays, such as a clock and a calculator. Active elements, such as a thin film transistor (TFT) which is a switching means to choose the pixel electrode which a pixel electrode is prepared in the shape of a matrix, and impresses an electrical potential difference to liquid crystal as the translucency substrate used for a liquid crystal display component, are prepared. Furthermore, color filter layers, such as red, green, and blue, are prepared as a color display means.
[0004] The active drive mold twist pneumatic (TN is called below Twisted Nematic:) liquid crystal display which made 90 degrees twist for it and carry out orientation of the twist angle of a liquid crystal molecule to this liquid crystal display according to the twist angle of a liquid-crystal molecule, the multiplexer drive mold super twist pneumatic (STN is called below SuperTwisted Nematic:) liquid crystal display which used steepness with a sharp transmission-liquid-crystal applied-voltage property by making the twist angle of a liquid-crystal molecule into 90 degrees or more are known.
[0005] By the way, in the above conventional liquid crystal displays, as shown in drawing 11 , the display screen of a liquid crystal display 28 is recognized by other observers 30 in addition to observer 29 of the direction of a transverse plane. For this reason, when protecting the privacy of the individual about an image, as shown in drawing 12 , the angle-of-visibility property of the display image of a liquid crystal display 28 can be narrowed, and a configuration which can be recognized only to the observer 29 of the direction of a transverse plane is desired. That is, according to the case where it recognizes only by the observer of the case where it sees by a lot of people, or the direction of a transverse plane, there is a request of making it want an angle-of-visibility property to be able to change easily.
[0006] In order to reply to this request, the angle-of-visibility control mold liquid crystal display as shown in drawing 13 is proposed (JP,5-108023,A). This angle-of-visibility control mold liquid crystal display is the thing of a configuration of having added the TN liquid crystal cell 35 for optical shutters to the TN liquid crystal cell 36 for a display. Polarizing plates 31 and 32, the TN liquid crystal cell 35 for optical shutters, and the optical-path control strip 37 are formed in the surface light source 34 side of the

TN liquid crystal cell 36 for a display, and, specifically, the polarizing plate 33 is formed in the opposite side. In this configuration, by carrying out switch actuation of the switching condition of the TN liquid crystal cell 35 for optical shutters, the image of the liquid crystal cell 36 for a display can be used as a wide-field-of-view angle, or it can change easily [a narrowed visual angle] that it should prevent being recognized by the 3rd person.

[0007]

[Problem(s) to be Solved by the Invention] However, in the angle-of-visibility control mold liquid crystal display of this proposal, there is a problem said that the polarizer of a total of three sheets is required, and permeability falls compared with conventional TN liquid crystal display or a conventional STN liquid crystal display also to the TN liquid crystal cell 35 for optical shutters since a polarizer is required. Moreover, since it is necessary to use an optical-path control strip 37 like a micro lens in order to make the pixel of TN liquid crystal cell for a display condense the light from TN liquid crystal cell for optical shutters, there is also a problem that product cost goes up.

[0008] It is made that the technical problem of such a conventional technique should be solved, the angle-of-visibility adjustable component which can control an angle-of-visibility property, and permeability comparable as the former are obtained, and moreover this invention can change an angle of visibility, and aims at offering the angle-of-visibility adjustable liquid crystal display in which production by low cost is possible.

[0009]

[Means for Solving the Problem] The orientation film is formed in each opposed face side of the translucency substrate of a pair with which the angle-of-visibility adjustable component of this invention according to claim 1 counters, between the substrates of this pair, to a substrate, at least, the liquid crystal layer which a liquid crystal molecule carries out orientation perpendicularly, and serves as a narrowed visual angle display mode is prepared, and the above-mentioned purpose is attained by that.

[0010] The angle-of-visibility adjustable component of this invention according to claim 2 is a configuration which the phase state of said liquid crystal layer changes, and serves as a wide-field-of-view angle display mode by change of the electrical potential difference impressed to said liquid crystal layer.

[0011] The angle-of-visibility adjustable component of this invention according to claim 3 is a configuration which the direction of orientation of said liquid crystal molecule changes, and serves as a wide-field-of-view angle display mode by change of the electrical potential difference impressed to said liquid crystal layer.

[0012] The angle-of-visibility adjustable component of this invention according to claim 4 is the configuration that it is a time of not impressing an electrical potential difference to said liquid crystal layer that the direction of orientation of said liquid crystal molecule becomes perpendicular to said substrate.

[0013] The angle-of-visibility adjustable component of this invention according to claim 5 is the configuration that it is a time of impressing an electrical potential difference to said liquid crystal layer that the direction of orientation of said liquid crystal molecule becomes perpendicular to said substrate, and the direction of orientation of a liquid crystal molecule becomes parallel to a substrate when not impressing an electrical potential difference to this liquid crystal layer.

[0014] The angle-of-visibility adjustable liquid crystal display of this invention according to claim 6 A transparent electrode layer and the orientation film are formed in each opposed face side of the translucency substrate of the pair which counters sequentially from [this] a substrate side. On both sides of this liquid crystal display component, the polarizer of a pair is prepared to the liquid crystal display component for image display with which the liquid crystal layer was prepared between the translucency substrates of this pair. Between [one / at least] this liquid crystal display component and this polarizer At least one angle-of-visibility adjustable component according to claim 2 or 3 is prepared, and the above-mentioned purpose is attained by that.

[0015] The angle-of-visibility adjustable liquid crystal display of this invention according to claim 7 A transparent electrode layer and the orientation film are formed in each opposed face side of the

translucency substrate of the pair which counters sequentially from [this] a substrate side. On both sides of this liquid crystal display component, the polarizer of a pair is prepared to the liquid crystal display component for image display with which the liquid crystal layer was prepared between the translucency substrates of this pair. Between [one / at least] this liquid crystal display component and this polarizer Two angle-of-visibility adjustable components according to claim 5 are prepared, and the above-mentioned purpose is attained by that. In this angle-of-visibility adjustable liquid crystal display, it is desirable to consider as the configuration which the direction of orientation of the liquid crystal molecule in said two angle-of-visibility adjustable components has at about 90 degrees mutually.
[0016] Below, an operation of this invention is explained.
[0017] The orientation film is formed in each opposed face side of the translucency substrate of a pair with which the angle-of-visibility adjustable component of this invention counters, and the liquid crystal layer which a liquid crystal molecule carries out orientation perpendicularly, and serves as a narrowed visual angle display mode is prepared at least to the substrate between the substrates of this pair. this liquid crystal layer -- a refractive-index anisotropy -- positive/negative -- any are sufficient.
[0018] For example, since the Tsunemitsu refractive index of a liquid crystal molecule is on a concentric circle when the liquid crystal molecule of a liquid crystal layer is carrying out orientation perpendicularly to the front face of a translucency substrate, and it sees from right above, even if it passes an angle-of-visibility adjustable component, the phase change of light does not arise. However, since the refractive index of the appearance of a liquid crystal molecule changes as a viewing angle is pushed down and it goes, the phase contrast of the light which passes an angle-of-visibility adjustable component arises. In this condition, recognition of images other than the right above direction becomes impossible. Here, this condition is called a narrowed visual angle display mode.
[0019] If the phase state of a liquid crystal layer changes and it becomes isotropy from this condition by impressing an electrical potential difference to a liquid crystal layer, even if it passes an angle-of-visibility adjustable component, change of the phase of light will not arise. Moreover, if an electrical potential difference is impressed to a liquid crystal layer and a liquid crystal molecule carries out orientation in parallel to a substrate, it will become the wide-field-of-view angle display mode which the phase contrast of light does not produce even if it passes an angle-of-visibility adjustable component.
[0020] If the direction of orientation and the direction of rubbing of a liquid crystal display component are made in parallel or perpendicular when the liquid crystal molecule of a liquid crystal layer is carrying out orientation of the angle-of-visibility adjustable liquid crystal display of this invention in parallel to the front face of the translucency substrate in an angle-of-visibility adjustable component, even if the light which penetrated or penetrates a liquid crystal display component passes an angle-of-visibility adjustable component, phase contrast will not produce it.
[0021] If the orientation condition of a liquid crystal layer changes and a liquid crystal molecule becomes perpendicular orientation from this condition by impressing an electrical potential difference to the liquid crystal layer in an angle-of-visibility adjustable component, it will become an above-mentioned narrowed visual angle display mode. At this time, sequence is not limited that what is necessary is just to have prepared the angle-of-visibility adjustable component between [at least one or more] the liquid crystal display and the polarizer.
[0022] On the other hand, in order that the phase contrast of the direction of a normal may not change two angle-of-visibility adjustable components to a substrate front face if it is made for the direction of orientation of a liquid crystal molecule to become about 90 degrees mutually when the liquid crystal molecule of a liquid crystal layer is carrying out orientation in parallel to the front face of the translucency substrate of an angle-of-visibility adjustable component, the use effectiveness of light can be gathered most and it becomes possible to extend an angle of visibility as a result.
[0023]
[Embodiment of the Invention] Below, the operation gestalt of this invention is explained, referring to a drawing. In addition, this invention is not limited by this. Moreover, in the following drawings, the same number was given to the part which has the same function.
[0024] Drawing 1 is the sectional view showing 1 operation gestalt of the angle-of-visibility adjustable

component of this invention. As for this angle-of-visibility adjustable component 1, the transparent electrode layers 4 and 5 which consist of ITO (Indium Tin Oxide) etc. are formed in the front face on which the translucency substrates 2 and 3 with which it consists of isotropic matter optically [a glass substrate or a transparent high polymer film] counter. The orientation film 6 and 7 which consists of polyimide or polyvinyl alcohol etc. by which perpendicular orientation processing was moreover carried out is formed. The liquid crystal layer 8 which consists of a pneumatic liquid crystal etc. is formed in the gap of both substrates.

[0025] This angle-of-visibility adjustable component 1 constitutes an angle-of-visibility adjustable liquid crystal display combining a liquid crystal display component or a polarizing plate, as shown in the sectional view of drawing 2 . In this liquid crystal display 38, the liquid crystal layer 17 which consists of a pneumatic liquid crystal etc. is enclosed with the gap of the translucency substrates 11 and 12 of pairs, such as a glass plate with which the orientation film 15 and 16 which consists of the transparent electrode layers 13 and 14 and polyimide which consist of ITO etc., polyvinyl alcohol, etc. was formed in the front face, and the closure of the liquid crystal display component 18 is carried out by the closure member which consists of resin etc.

[0026] Polarizers 9 and 10 are arranged at the both sides of this liquid crystal display component 18, and the angle-of-visibility adjustable component 1 is arranged between the liquid crystal display component 18 and the polarizer 9.

[0027] Drawing 3 is the decomposition perspective view of the liquid crystal display 38 of drawing 2 . In the liquid crystal display component 18, rubbing processing of each front face of the orientation film 15 and 16 is beforehand carried out so that a liquid crystal molecule may carry out about 90-degree twist orientation. The direction of rubbing of the orientation film 15 on a glass substrate 11 is the direction of an arrow head 19, and the direction of rubbing of the orientation film 16 on a glass substrate 12 is the direction of the perpendicular arrow head 20 to an arrow head 19.

[0028] The transparency shaft 21 of a polarizer 9 and the transparency shaft 22 of a polarizer 10 are arranged so that it may intersect perpendicularly mutually, and they are arranged so that the transparency shaft 22 of a polarizer 10 and the direction 20 of rubbing of the orientation film 16 of the liquid crystal display component 18 may become parallel mutually. For this reason, when not impressing an electrical potential difference to the liquid crystal layer 17 of the liquid crystal display component 18, the liquid crystal display 38 serves as the so-called normally white mode which penetrates light and performs a white display.

[0029] As an approach of changing an angle of visibility using this angle-of-visibility adjustable component 1, the approach of changing the phase state of ** liquid crystal layer, and the approach of carrying out ** orientation change are explained below.

[0030] ** Carry out orientation of the liquid crystal molecule of the liquid crystal layer 8 perpendicularly to the front face of the translucency substrates 2 and 3 in the approach above-mentioned angle-of-visibility adjustable component 1 to which the phase state of the liquid crystal layer 8 of the angle-of-visibility adjustable component 1 is changed at the time of no electrical-potential-difference impressing by using the orientation film by which perpendicular orientation processing was carried out as orientation film 6 and 7.

[0031] In this condition, as shown, for example in drawing 4 , the Tsunemitsu refractive index no of a liquid crystal molecule is on a concentric circle like the case where a refractive-index anisotropy sees the forward liquid crystal molecule 23 from right above. For this reason, as shown in drawing 5 , when a liquid crystal display 38 is seen from right above, even if the light which has penetrated the liquid crystal display component 18 passes the angle-of-visibility adjustable component 1, change of a phase does not arise. Therefore, the image which is not different from the conventional liquid crystal display at all can be recognized.

[0032] On the other hand, it changes, as the refractive index of the appearance of the liquid crystal molecule in the angle-of-visibility adjustable component 1 is shown in drawing 6 , and apparent Tsunemitsu refractive-index no' and apparent abnormality **** refractive-index ne' come to exist as a viewing angle is pushed down and it goes to every direction of [other than right above]. For this

reason, if the light which has passed the liquid crystal display component 18 passes the angle-of-visibility adjustable component 1 when a viewing angle is pushed down and a liquid crystal display 38 is seen, as shown in drawing 7 , phase contrast will arise. It becomes impossible therefore, to recognize the image from the liquid crystal display component 18. Therefore, it becomes impossible for other observers 30 except observer 29 of the direction of a transverse plane shown in drawing 11 to look at an image, and they become a narrowed visual angle display mode.

[0033] To this angle-of-visibility adjustable component 1, an electrical potential difference is impressed between the transparent electrode layer 4 and 5, and by making it **** [phase state / of the liquid crystal layer 8], as shown in drawing 8 , even if the light which has penetrated the liquid crystal display component 18 to all the directions passes the angle-of-visibility adjustable component 1, change of a phase does not arise. Therefore, other observers 30 other than observer 29 of the direction of a transverse plane shown in drawing 12 can see an image, and can consider as the usual wide-field-of-view angle display mode.

[0034] Therefore, it can be made to change from a narrowed visual angle display mode to the usual wide-field-of-view angle display mode simply by carrying out electrical-potential-difference impression by carrying out perpendicular orientation of the liquid crystal molecule of an angle-of-visibility adjustable component to a substrate front face at the time of no electrical-potential-difference impressing.

[0035] ** In the approach above-mentioned angle-of-visibility adjustable component 1 to which the orientation condition of the liquid crystal layer 8 of the angle-of-visibility adjustable component 1 is changed, as shown in drawing 9 , carry out orientation of the liquid crystal molecule 23 of the liquid crystal layer 8 in parallel to the front face of the translucency substrates 2 and 3 at the time of no electrical-potential-difference impressing.

[0036] If it is made to arrange so that the direction of parallel orientation of the liquid crystal molecule 23 of this angle-of-visibility adjustable component 1 and the direction of rubbing of each orientation film 15 and 16 of the liquid crystal display component 18 may become perpendicularly or parallel, the oscillating direction of the light which penetrates the liquid crystal display component 18, or the penetrated light will become in parallel or perpendicular to the liquid crystal molecular orientation in the angle-of-visibility adjustable component 1. For this reason, if a liquid crystal display 38 is seen from right above, phase contrast will not be produced even if the light which has penetrated or penetrated the liquid crystal display component 18 passes the angle-of-visibility adjustable component 1. Therefore, the image which is not different from the conventional liquid crystal display at all can be recognized.

[0037] In this case, although phase contrast arises as a viewing angle is pushed down, an image can be made to display it as the angle-of-visibility property of the conventional liquid crystal display practically equal by optimizing the cel gap of refractive-index anisotropy deltan of the liquid crystal ingredient of the angle-of-visibility adjustable component 1, or the angle-of-visibility adjustable component 1. Therefore, other observers 30 other than observer 29 of the direction of a transverse plane shown in drawing 12 can see an image, and can consider as the usual wide-field-of-view angle display mode.

[0038] Moreover, using the angle-of-visibility adjustable component 1 shown in drawing 1 , and the same angle-of-visibility adjustable component two sheets, as shown in drawing 10 , the angle-of-visibility property in a longitudinal direction can be made into the symmetry by arranging so that the directions 24 and 25 of orientation of each angle-of-visibility adjustable component 1 and the liquid crystal molecule 23 in one may become about 90 degrees.

[0039] If an electrical potential difference is impressed between the transparent electrode layer 4 and 5 to this angle-of-visibility adjustable component 1, since the direction of orientation of the liquid crystal molecule 23 of the liquid crystal layer 8 will become perpendicular to substrates 2 and 3, like the time of electrical-potential-difference impression of the approach of above-mentioned **, it becomes impossible for other observers 30 except observer 29 of the direction of a transverse plane shown in drawing 11 to look at an image, and they become a narrowed visual angle display mode. Therefore, it can be made to change from the usual wide-field-of-view angle display mode to a narrowed visual angle display mode simply by carrying out electrical-potential-difference impression by carrying out parallel orientation of

the liquid crystal molecule of an angle-of-visibility adjustable component to a substrate front face at the time of no electrical-potential-difference impressing.

[0040] Thus, according to this invention, an angle of visibility can be changed by impressing an electrical potential difference to an angle-of-visibility adjustable component. In addition, the liquid crystal ingredient of an angle-of-visibility adjustable component can be used regardless of the positive/negative of a refractive-index anisotropy.

[0041] Moreover, if it is between the polarizers of a pair in a liquid crystal display, even if the angle-of-visibility adjustable component is arranged at any, phase compensation is possible for the angle-of-visibility adjustable component of this invention, since the angle-of-visibility property is changed by operating the phase of light. Moreover, in the liquid crystal display of this invention, like the conventional angle-of-visibility control mold liquid crystal display, since the polarizer of the 3rd sheet for TN liquid crystal cell for optical shutters is unnecessary, permeability does not fall compared with TN liquid crystal display or a STN liquid crystal display, and since an optical control strip does not have the need, either, the problem that a manufacturing cost becomes high is not produced, either. Moreover, the sequence including a liquid crystal display component does not need to be limited, and the angle-of-visibility adjustable component 1 may be arranged between the polarizer 10 and the liquid crystal display component 18. Furthermore, the angle-of-visibility adjustable component of two or more sheets of two or more sheets may be prepared.

[0042] Moreover, in the liquid crystal display of this invention, when arranging the transparency shaft of a polarizer in parallel mutually and not impressing an electrical potential difference, also in the case of the normally black mode in which a black display is performed, it can apply.

[0043]

[Example 1] In this example 1, the liquid crystal display 38 as shown in drawing 3 was produced.

[0044] As a liquid crystal layer of the liquid crystal display component 18, the pneumatic liquid crystal ingredient whose transition temperature TNI of a nematic phase-isotropic phase is about 100 degrees C was used. Moreover, for example, the transition temperature TNI of a nematic phase-isotropic phase was lower than TNI of the liquid crystal layer of a liquid crystal display component, when not impressing an electrical potential difference to the angle-of-visibility adjustable component 1 using a 40-degree C pneumatic liquid crystal ingredient as a liquid crystal layer 8 of the angle-of-visibility adjustable component 1, the liquid crystal molecule in the liquid crystal layer 8 was made to carry out orientation perpendicularly to the front face of the translucency substrates 2 and 3.

[0045] Temperature is raised with a heating means so that an electrical potential difference may be impressed to the angle-of-visibility adjustable component 1, and the phase state of the liquid crystal layer of the liquid crystal display component 18 can be maintained at a liquid crystal phase to this liquid crystal display 38 and the liquid crystal layer 8 of the angle-of-visibility adjustable component 1 may be in an isotropic phase condition.

[0046] Thus, where an electrical potential difference is impressed to the angle-of-visibility adjustable component 1, only the liquid crystal layer 8 of the angle-of-visibility adjustable component 1 becomes an isotropic phase. For this reason, even if the light which has penetrated the liquid crystal display component 18 passes the angle-of-visibility adjustable component 1, it does not receive change of a phase. Therefore, the same angle-of-visibility property as the conventional liquid crystal display can be acquired.

[0047] On the other hand, in the condition of not impressing an electrical potential difference, the liquid crystal molecule in the liquid crystal layer 8 of the angle-of-visibility adjustable component 1 is carrying out orientation to the angle-of-visibility adjustable component 1 perpendicularly to the translucency substrates 2 and 3. For this reason, when it sees from right above to a liquid crystal display 38, there is no change in a display property, but even if it pushes down a viewing angle in which direction and goes, when the light which has penetrated the liquid crystal display component 18 passes the angle-of-visibility adjustable component 1, the delay of a phase arises. Therefore, it becomes possible to prevent from recognizing as an image.

[0048] Thus, by impressing an electrical potential difference to the angle-of-visibility adjustable

component 1, or making it no impressing, the phase state of the liquid crystal layer 8 can be indirectly changed by the temperature change, and the angle-of-visibility property of a liquid crystal display 38 can be changed.

[0049]

[Example 2] In this example 2, the liquid crystal display 38 as shown in drawing 10 was produced.

[0050] Refractive-index anisotropy deltan set the thickness of a liquid crystal layer as 4.5 micrometers, using the pneumatic liquid crystal ingredient of 0.08-0.10 as a liquid crystal layer of the liquid crystal display component 18. moreover, as a liquid crystal layer 8 of the angle-of-visibility adjustable component 1 When not impressing an electrical potential difference to the angle-of-visibility adjustable component 1 using a pneumatic liquid crystal ingredient The liquid crystal molecule carried out orientation in parallel to the front face of the translucency substrates 2 and 3 within the liquid crystal layer 8, and further, as the directions 24 and 25 of parallel orientation carried out orientation in parallel and perpendicularly to the direction of rubbing of the translucency substrates 15 and 16 of the liquid crystal display component 18, they carried out the two-sheet laminating of the angle-of-visibility adjustable component 1.

[0051] When not impressing an electrical potential difference to the angle-of-visibility adjustable component 1 to this liquid crystal display 38, the oscillating direction of the light which has penetrated the liquid crystal display component 18 becomes in parallel or perpendicular to the directions 24 and 25 of liquid crystal molecular orientation of the angle-of-visibility adjustable components 1 and 1. For this reason, when a liquid crystal display 38 is seen from right above, even if the light which has penetrated the liquid crystal display component 18 passes the angle-of-visibility adjustable components 1 and 1, phase contrast is not produced but the image which is not different from the conventional liquid crystal display at all can be recognized.

[0052] In this case, although a phase changes compared with the conventional liquid crystal display as a viewing angle is pushed down, an image can be made to display it as the angle-of-visibility property of the conventional liquid crystal display practically equal like this example 2 by optimizing the cel gap of refractive-index anisotropy deltan of the liquid crystal ingredient of the angle-of-visibility adjustable components 1 and 1, or the angle-of-visibility adjustable component 1.

[0053] On the other hand, where an electrical potential difference is impressed, orientation of the liquid crystal molecule in the liquid crystal layer 8 of the angle-of-visibility adjustable component 1 is perpendicularly carried out to the angle-of-visibility adjustable component 1 to the translucency substrates 2 and 3. For this reason, when it sees from right above to a liquid crystal display 38, there is no change in a display property, but even if it pushes down a viewing angle in which direction and goes, when the light which has penetrated the liquid crystal display component 18 passes the angle-of-visibility adjustable component 1, the delay of a phase arises. Therefore, it becomes possible to prevent from recognizing as an image.

[0054] Thus, by impressing an electrical potential difference to the angle-of-visibility adjustable components 1 and 1, or making it no impressing, the orientation condition condition of the liquid crystal layer 8 can be changed, and the angle-of-visibility property of a liquid crystal display 38 can be changed.

[0055]

[Effect of the Invention] According to this invention, there is the following effectiveness so that clearly from the above explanation.

(1) According to the angle-of-visibility adjustable component of this invention, since an angle-of-visibility property can be changed by the easy change which is not impressed [electrical-potential-difference impression or], the angle-of-visibility property of a liquid crystal display can be changed by easy actuation.

[0056] (2) Since according to the angle-of-visibility good transformation liquid crystal display of this invention the phase of light does not change when it sees from right above, even if compared with conventional TN mold and a conventional STN mold liquid crystal display, image display can be performed practically equal in respect of permeability.

[0057] (3) According to the angle-of-visibility good transformation liquid crystal display of this invention, compared with the conventional angle-of-visibility control mold liquid crystal display which needs the polarizer of three sheets, a micro lens, etc., an angle of visibility can be changed by low cost.

[Translation done.]

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DESCRIPTION OF DRAWINGS

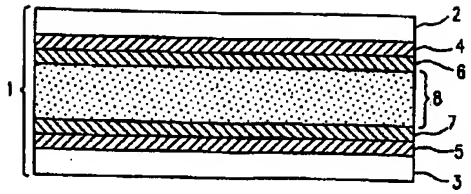
[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing 1 operation gestalt of the angle-of-visibility adjustable component of this invention.
[Drawing 2] It is the sectional view showing 1 operation gestalt of the angle-of-visibility adjustable liquid crystal display of this invention.
[Drawing 3] It is the perspective view of the angle-of-visibility good transformation liquid crystal display of an example 1.
[Drawing 4] While the liquid crystal molecule in an angle-of-visibility adjustable component is carrying out perpendicular orientation, it is a schematic diagram at the time of seeing a liquid crystal molecule from right above.
[Drawing 5] While the liquid crystal molecule in an angle-of-visibility adjustable component is carrying out perpendicular orientation, it is a schematic diagram at the time of seeing a liquid crystal display from right above.
[Drawing 6] While the liquid crystal molecule in an angle-of-visibility adjustable component is carrying out perpendicular orientation, it is a schematic diagram at the time of pushing down a viewing angle and seeing a liquid crystal molecule from across.
[Drawing 7] While the liquid crystal molecule in an angle-of-visibility adjustable component is carrying out perpendicular orientation, it is a schematic diagram at the time of pushing down a viewing angle and seeing a liquid crystal display from across.
[Drawing 8] When the liquid crystal layer in an angle-of-visibility adjustable component is in an isotropic phase condition, it is a schematic diagram at the time of seeing a liquid crystal display from all.

[Drawing 9] In the angle-of-visibility adjustable component of drawing 1 , it is the sectional view showing the case where the liquid crystal molecule is carrying out parallel orientation.
[Drawing 10] It is the perspective view of the angle-of-visibility good transformation liquid crystal display of an example 1.
[Drawing 11] It is the schematic diagram showing the case where a liquid crystal display is displayed with a narrowed visual angle display mode.
[Drawing 12] It is the schematic diagram showing the case where a liquid crystal display is displayed with the usual wide-field-of-view angle display mode.
[Drawing 13] It is the perspective view showing the configuration of the conventional angle-of-visibility control mold liquid crystal display.
[Description of Notations]
1 Angle-of-Visibility Adjustable Component
2, 3, 11, 12 Translucency substrate
4, 5, 13, 14 Transparent electrode layer
6, 7, 15, 16 Orientation film
8 Liquid Crystal Layer

9 Ten Polarizer
17 23 Liquid crystal molecule
18 Liquid Crystal Display Component
19 20 Arrow head (the direction of rubbing)
21 22 Transparency shaft
24 25 The direction of orientation
29 Observer of the Direction of Transverse Plane
30 Other Observers
38 Liquid Crystal Display

[Translation done.]

【図１】



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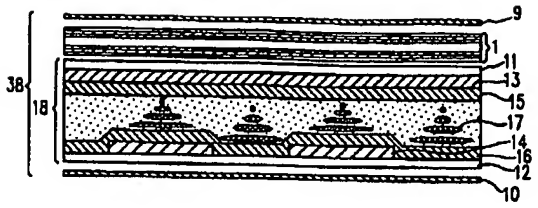

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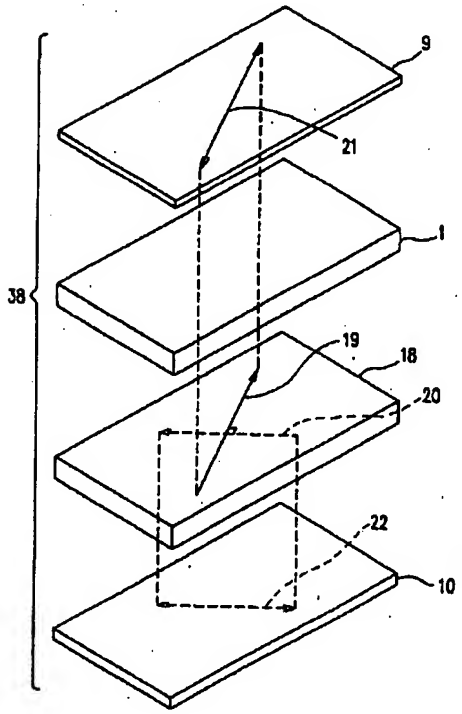
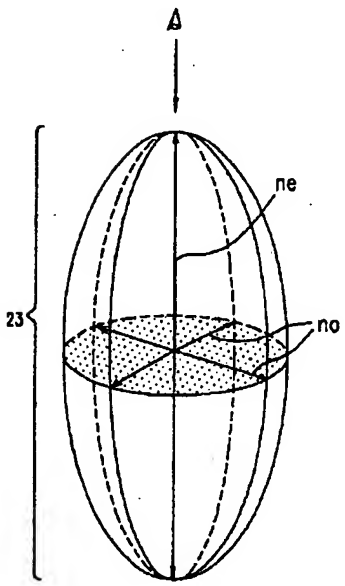


【図４】



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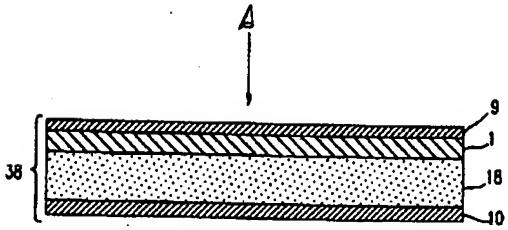

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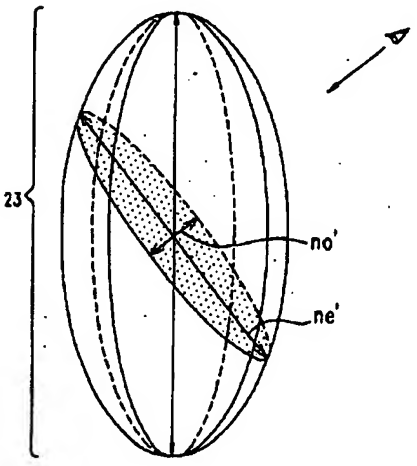

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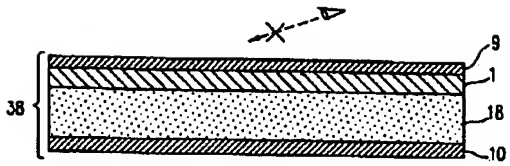

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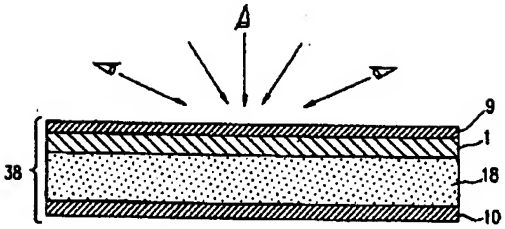

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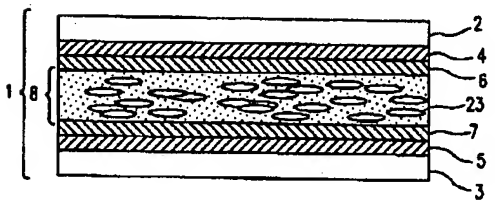

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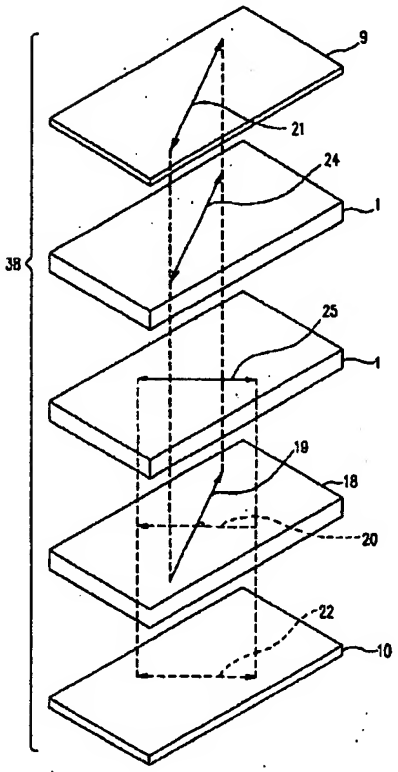

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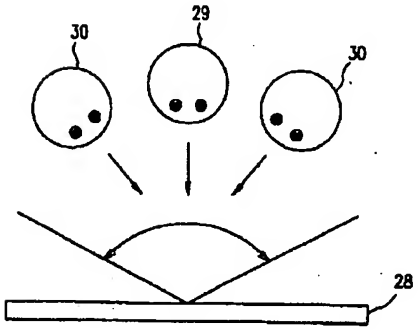

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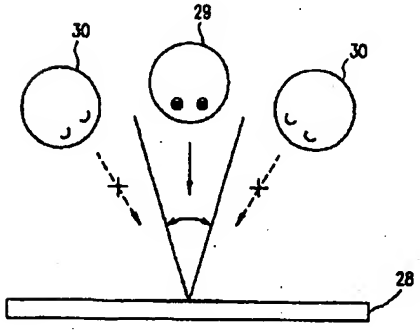

【図１３】